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THE DWARFING, SHRIVELING, AND DROPPING OF CHERRIES AND PRUNES

W. O. GLOYER

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Bulletin No. 540

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W. O. GLOYER

ABSTRACT

The fungus constantly associated with the lesions on the pedicels of the English Morello cherry did not prove it to be the causal agent of the condition described as "small cherry". The fungus has been identified as *Coniothyrium olivaceum*. It is present as a saprophyte on the pedicels, fruit, and epidermis of the one- and two-year-old twigs.

The lesions on the pedicels, which tend to obstruct the sap flow, were produced by applications of acid lead arsenate in water. Orchard practice; seasonal conditions; mechanical, insect, or spray injury; and fungal and bacterial infection may influence the size of the fruit. Further investigation is required to determine the relative importance of these factors as contributing agents in producing "small cherry". Nevertheless, the data definitely show that the pedicel injury, and the subsequent dropping and dwarfing of the fruit, should unquestionably be attributed to lead arsenate.

The injury was associated with lead arsenate when combined with bordeaux, lime sulfur, wettable sulfur, or sulfur dust. The least injury was noted where light applications of the last two fungicides were made. Their efficiency in combating the shot-hole fungus *Coccomyces hiemalis* was not established, since there was but a light infection during the year.

For the applications made after petal fall and again after shucks fall, lime-sulfur solution appeared to be the most efficient for leaf-spot control. For the later periods the use of light applications of either wettable sulfur or sulfur-lead-arsenate dust insured the least pedicel injury. As the fruit is ripening an application of lime-sulfur solution alone should be avoided as it discolors and dwarfs the fruit.

Applications of lead arsenate also caused injury to various varieties of prunes similar to that produced on the English Morello cherry.

INTRODUCTION

Growers of English Morello cherries have often observed that a portion of the crop is under size and worthless. To such dwarfed

fruit the orchardist has applied the term "small cherry"; and as the writer has been unable to find a better term, he has adopted that name which aptly describes this condition. The cause of the shriveling of the fruit has been quite a mystery, due to the fact that lesser contributing factors have often been mistaken for the primary agent.

In undertaking the investigation of this problem, the writer at the outset assumed that the causal agent was a common fungus which was universally present on the pedicels of dwarfed cherries. An attempt was made to control this fungus by means of lime-sulfur solution, making applications at such times as seemed necessary. During the course of the investigation, the writer soon became aware of the fact that the English Morello cherry readily reacted to an unfavorable environment. The cause of the small cherry was found to be due partly to its environment, but injury due to sprays applied in combating fungus and insect pests appeared to be the predominating factor.

After it had been found that the fungus was not the causal agent of "small cherry" the investigation was broadened to cover a similar injury of prunes. As in the case of the cherry, it was found that applications of sprays produced the dropping, shriveling, and dwarfing of the fruit.

OBSERVATIONS OF 1925

"Small cherry" was first brought to the attention of the writer by F. P. Schlatter, of the United States Department of Agriculture who had been carrying on experimental work at Sodus, N. Y. On August 5, 1925, he submitted specimens of shriveled, dwarfed fruit of the English Morello to determine the causal agent. Branches taken from trees sprayed with dry lime-sulfur plus lead arsenate, and others with a proprietary bordeaux plus lead arsenate, showed 20 and 5 per cent, respectively, of injured fruit. The branches from check trees to which lead arsenate alone was applied showed 50 per cent of the fruit injured. It appeared that of the fungicides used the application of bordeaux was more efficient than the dry lime-sulfur in controlling the causal agent; and that the arsenate of lead showed very little fungicidal value.

An examination of the fruit showed it in all stages of desiccation. On the same branches large, glossy fruit was found next to the mummied cherries. Between these extremes there could be found all intermediate stages as is shown in Plates I and II. The first notice

that the orchardist has that something is wrong with the crop is the failure of the fruit to increase in size. Especially is this the case during the last two weeks prior to picking. The normal cherries fill out rapidly and greatly increase in size after the rains that fall in this period, while some of the fruit gradually shows loss of turgidity and shriveling and becomes dull in appearance. Wrinkles then begin to appear about the stem end, and finally, the fruit is completely shriveled. In some cases there is a marked depression about the stem which is of a darker color. Up to this period the fruit appears free from fungi, tho they may appear later. The fruit with the depression about the stem generally drops, while the fruit that has gradually shriveled clings to the tree and may still be found on the tree the following spring. It resembles the mummied fruit resulting from the infection of the brown-rot organism *Sclerotinia cinerea* (Bon.) Schrot. This fungus, however, was not present, for the English Morello shows a high degree of resistance to it and is seldom attacked.

The presence of lesions on the pedicels or fruit stems may account for the obstruction of the sap flow. Such lesions are first a bright red, then brown in the center with a bright margin, and finally, the entire lesion turns brown. The lesions are usually found at the distal end near the place of fruit attachment. Less frequently, they are found near the basal end and in the intervening tissue. At first, such lesions may be only 3 to 5 mm. in length, but ultimately the entire pedicel turns brown and becomes withered. In some cases an abscission layer is formed between the twig and the pedicel and the fruit falls to the ground. More often the pedicels cling to the twig thruout the winter.

The appearance of the lesions on the pedicels examined suggested the invasion of some fungus which had cut off the sap flow. The pycnidia of a fungus belonging to the genus Coniothyrium were present on the older lesions. When the fruit and the pedicels were placed in a damp chamber, the fruiting bodies of the fungus developed on all pedicels showing lesions.

In reviewing the literature it was found that a similar injury was described by Dutton (2)[1] in Michigan. He noted the presence of a canker at the base of the pedicel. The fungus present was identified by Ray Nelson as *Coniothyrium fuckelii*, which is the organism causing the cane blight of raspberry. It was found on 90–10 sulfur-lead-

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[1]Refers to Literature Cited, page 18.

arsenate dusted plats, while those sprayed with lime-sulfur plus lead arsenate were free from the injury.

An examination of the orchards about Geneva was made to ascertain if "small cherry" were present. Failure to find it in the Station orchard was attributed to thoro spraying. The Fred Hammond orchard, which was sprayed with lime-sulfur 1–40, plus 2½ pounds of powdered lead arsenate to 100 gallons, showed 5 per cent of the fruit injured, while some of the trees were not picked because of "small cherry". The nearby orchard of Willard McKay was given a similar spray but using 3 pounds of lead arsenate. About one-third of the crop was a loss because of the injury. He also reported that a similar condition existed the previous year. Specimens and reports were received from Herbert King of Trumansburg, Howard A. Hopkins of Youngstown, N. Y., and A. T. Henry of Wallingford, Conn., indicating that the injury was not local but widespread. An examination of the trees in winter showed the presence of the fungus on the mummied fruit, on the dried pedicels, and also on the gray epidermis of the one- and two-year-old portions of the twigs. On the two-year-old tissue the epidermis had been weathered away except on the protected sides. The fungus did not appear to be parasitic, altho, due to arsenical injury, cankers of red brown tissue 5 to 8 mm. long had been formed about the buds.

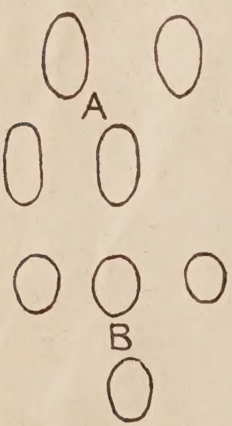

FIG. 1.
(A) Spores of *C. olivaceum*.
(B) Spores of *C. fuckelii*.

Besides Alternaria and other saprophytes, a fungus belonging to the genus Coniothyrium was present on specimens collected from various parts of the State. The fungus was readily isolated by teasing out a pycnidium and making a dilution culture. The isolations from the fruit, pedicels, and epidermis of the one-year twigs showed the same fungus thruout. While variations did occur, such differences are expected from this type of organism. The spore measurements averaged 5.70 by 3.27 μ. and varied from 5 to 6.3 by 3.2 to 3.5 μ. When compared with *Coniothyrium fuckelii*, which had been collected by Stewart (11) on the raspberry, they were found not to be identical. The spores of the latter are globose and measure 4 by 3 μ. Differences became apparent when spores from both organisms were

placed side by side (Fig. 1). Also, the cultural characteristics of the fungus on the cherry are not those of *C. fuckelii*. The measurements do not agree with *C. cerasi* Passer., but appeared to be identical with *C. olivaceum* Bon. found on other hosts in the Station herbarium. Hence, it appears that the fungus is not *C. fuckelii*, but a common fungus, *C. olivaceum* Bon., which is found on many hosts (9).

STUDIES WITH CHERRIES IN 1926

The observations made by the writer did not completely agree and they appeared to conflict with the observations of Dutton (2). He found "small cherry" present in dusted plats, while those given an application of lime-sulfur solution were free from this injury. The writer, on the other hand, found the injury abundant in orchards receiving lime-sulfur sprays to which lead arsenate had been added. Hence, it was evident that if the causal agent of "small cherry" is a fungus, several avenues were opened for further experimentation. Either the lime-sulfur solution was not applied thoroly or the applications were not properly timed. These and other problems were tested out in the orchard of Willard McKay where "small cherry" was abundant the previous year.

SPRAYING EXPERIMENTS

As the English Morello is subject neither to the San Jose scale nor susceptible to the brown-rot fungus, the preblossom sprays had been omitted, as is the custom with this variety about Geneva. The variety is susceptible to the fungus *Coccomyces hiemalis* which causes the disease known as leaf-blight or shot-hole leaf-spot. For its control lime-sulfur 1–40 is used, while lead arsenate 2½ to 3 pounds to 100 gallons is added for the control of insect pests. The test orchard was 13 years old and consisted of 12 rows of 28 trees per row and the first tree in each row served as a check. The following applications of 1–40 lime-sulfur solution were made by means of a spray-gun with a pressure of 300 to 350 pounds.

June 3. All trees in rows 1 to 6 sprayed without lead arsenate.

July 3. Entire orchard sprayed; lead arsenate added.

July 15. Entire orchard sprayed; lead arsenate added. After the orchard was sprayed, rows 1 and 2 were again covered so as to have an excess of spray present.

July 29. Trees 2 to 14 of all rows sprayed without lead arsenate.

On June 16, two check trees had been sprayed by means of a bucket pump, using powdered lead arsenate at the rate of 2½ pounds to 100 gallons of water. Two other trees received a double amount of the insecticide. On July 15 these applications were repeated.

Observations.—From time to time observations were made and the outstanding features only are recorded here.

On July 10, leaf-spot and defoliation were observed in rows 7 to 12, indicating that the application of June 3 prevented infection in rows 1 to 6. No lesions of any kind were observed on the pedicels. Some of the cherries turned a bright red, while the majority were still green.

On July 15, thruout the entire orchard, bright red discolorations were observed at the distal end of some pedicels. None were observed on the checks.

On July 29, most of the cherries had turned dark red, while an occasional cherry was still bright red. Some of the bright spots on the pedicels had taken on a brown color and still retained the bright margin.

On August 6, lime-sulfur alone applied July 29 to trees 2 to 14 checked the development of the fruit and caused the foliage to turn the edges upward, indicating foliage injury. The fruit failed to fill out after the rains and became dull and lost its gloss. It appeared that the fungicide combined with the outer surface covering of the fruit so as to permit greater evaporation as the cherries soon began to shrink in size. The cherries on trees 15 to 28 increased in size and retained their gloss. Because of the spray injury it was necessary to harvest the fruit 7 to 10 days earlier than the neighboring orchards.

The application of July 29 did not increase the amount of visible pedicel injury, altho it is possible that if the fruit had been permitted to hang longer further injury might have developed. Rows 1 and 2 which had been given a double dosage of spray on July 15 showed from 10 to 20 per cent pedicel injury. Rows 3 to 12 showed from 1 to 8 per cent, or an average of 3.3 per cent of the pedicels injured. The injury on the pedicel was usually found at the distal end where the excess spray accumulated, and such injury was correlated with the undersize fruit. The smallest cherries were found in rows 1 and 2.

The checks which had not received an application of spray during the season showed large glossy fruit, free from pedicel injury, tho there was defoliation due to the shot-hole leaf-spot. The matter of

insect infestation was not considered, as that subject was not within the sphere of this investigation and has been more fully considered by Glasgow and Gambrell (6).

OBSERVATIONS WHERE LEAD ARSENATE ALONE WAS APPLIED

As the season advanced it became evident that the few trees sprayed with lead arsenate in water would furnish the best explanation of the cause of pedicel injury. On July 10, a slight reddish discoloration of the pedicels was observed at the distal end. On July 19, this discoloration had taken on the aspect of a definite lesion and resembled the red-brown lesions observed the previous year. The lesions were mostly at the distal end, less at the proximal end and the intervening tissue. Trees sprayed with 2½ pounds of lead arsenate showed less injury than those receiving the double dosage. On July 26, injury was apparent for the fruit was undersized and shriveled. From this time until picking on August 6, the fruit dried rapidly and the lesions extended in some cases to the entire pedicel. One of the trees sprayed with 2½ pounds of lead arsenate to 100 gallons of water showed 30 per cent and the other one 85 per cent of the fruit under size, while both the trees receiving the double dosage showed 95 per cent of injured fruit. In the latter case the pedicels had withered and the fruit was badly sunken about the pedicel and dropped from the tree, while in other cases the fruit had shrunken to a mummified condition and hung tenaciously to the twig.

Pedicels from various plats were taken into the laboratory and examined to see if the fungus observed the previous year could be found again. It was easily found on the pedicels taken from trees sprayed with lead arsenate and, when placed in the damp chamber, the fungus was found on all pedicels showing lesions. The pedicels taken from the unsprayed trees remained green during the interval and were free from the fungus *Coniothyrium olivaceum*.

Attempts were made to produce the pedicel lesions by spraying fruit with pure cultures of the fungus, but in all cases the results were negative. Hence, it was concluded that the primary injury was due to lead arsenate and that the fungus present was merely a saprophyte that invaded the injured tissue.

OTHER CAUSES OF DWARFED FRUIT

During the 1926 season it was observed that there were contributing causes other than lead arsenate or fungicides that may produce small

fruit. In some orchards it was observed that the English Morello has a tendency to produce bud sports which ripen their fruit 10 to 14 days later than the normal. Often a twig, branch, half of a tree, or even the entire tree may show this characteristic year after year. Such fruit at the time of harvesting the normal fruit may be undersize because it has not made its full growth. This was evident on July 26 when some trees showed fruit just turning red, while other fruit was a very dark red color. It was thought possible that the fruit that was ready to pick on this day would tend to dry or shrivel on hanging longer. On unsprayed trees such fruit was marked with India ink, and on August 6, it had not decreased in size. Hence, it was concluded that the early ripening was not a causal factor in the production of dwarfed fruit.

The cultural practises in the orchard may also cause undersize fruit. Trees that have been prematurely defoliated or grown in sod may show fruit that does not fill out as readily as fruit in cultivated orchards. The latter tends to have longer terminal growth, whereas in sod the terminal growth may be limited to 5 to 6 inches. Where the location of the orchard is such that cultivation cannot be practised, it is advisable to stimulate the trees by the addition of 1 to 2 pounds of sodium nitrate per tree. Also, trees with an abundance of foliage tend to shade the fruit and minimize any effect that pedicel injury may exert on flow of sap necessary to produce the maximum size.

Mechanical injuries and an occasional infection of the brown-rot fungus may cause small or mummified cherries, but they can be readily distinguished from those injured by lead arsenate. Sackett (10) described a bacterial disease of the Wragg cherry, considered the same as the English Morello, in Colorado, due to *Phytomonas cerasi wraggi* which causes a leaf-spot and a mummification of the fruit. He found that either bordeaux or lime-sulfur reduced the damage from this organism, but that both caused an undesirable dwarfing.

OBSERVATIONS IN OTHER ORCHARDS

In August the writer had an opportunity to visit the spray plats of F. P. Schlatter, who was conducting experiments for the United States Department of Agriculture at Sodus, N. Y., and found that his results substantiated the conclusion that lead arsenate was the causal agent.

PLATE I.—TWIG OF ENGLISH MORELLO SHOWING "SMALL CHERRY" AT HARVEST IN 1925.

The fungus *Coniothyrium olivaceum*, which was growing on the pedicels, proved to be a saprophyte growing on the lesions produced by lead arsenate.

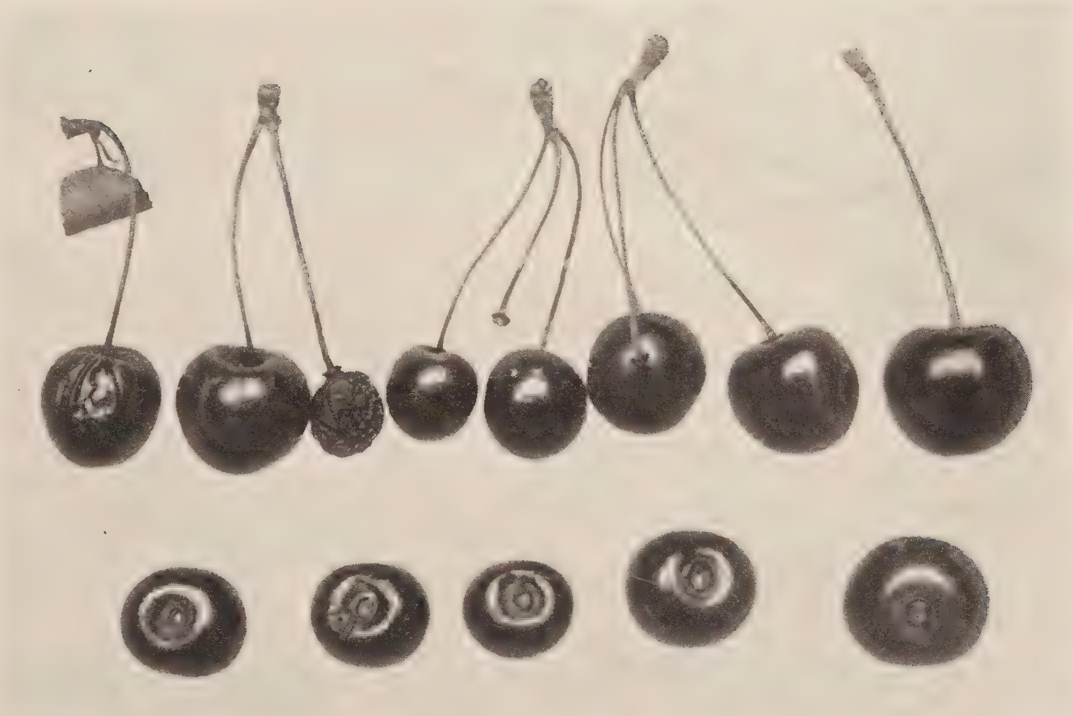

Plate II.—Fruit of English Morello at Harvest in 1926 Showed Less Shrinking than was Observed the Previous Year.

The lower row of fruit shows the sunken, darkened areas about the place of attachment. The fruit at the left was taken from trees sprayed with lead arsenate in water, while the fruit at the extreme right was taken from an unsprayed tree.

Plate III.—Effect of Spraying German Prune with Lead Arsenate in Water.

The injury to the pedicels obstructed the sap flow so as to cause the fruit to shrivel and drop prematurely. The fruit at the right was unsprayed.

PLATE IV.—EFFECT OF SPRAYING ITALIAN PRUNE WITH LEAD ARSENATE IN WATER.

The fruit dropped prematurely and but few hung to the tree so as to cause a shriveling at the stem end. The fruit at the right was unsprayed.

Pedicel injury to Montmorency fruit was present only in amounts that could be considered as a trace, and hence of no commercial importance in 1926. Taken as a whole the English Morello orchards showed less "small cherry" in 1926 than was observed in 1925. This was due to seasonal conditions. In 1925, the cherries were subject to almost drought conditions prior to harvesting, while in 1926 cool weather prevailed with rains well distributed. With a restricted sap flow, defoliation, hot weather, and a high percentage of pedicel injury, "small cherry" was abundant in 1925. In 1926, some of these conditions were lacking. With cool weather, slight defoliation, and a small amount of pedicel injury, there was but little "small cherry". Fruit with pedicel injury which was permitted to hang unduly long, so as to experience the hot dry weather that occurred later, showed as much "small cherry" and dropping as was found in 1925.

It may not be out of place to present a summary of the results of spraying practises as found in this and other states. In the past, investigators have failed to recognize the injurious effect of acid lead arsenate, and hence it is difficult to ascertain just how much of the injury reported can be attributed to the fungicide if lead arsenate was combined with it.

Bordeaux mixture.—Copper sprays have been discontinued for some time for use on the English Morello due to injury to the foliage and fruit. This had been observed by local orchardists, and Dutton and Wells (3), in a general statement, note that Pyrox caused foliage injury and defoliation, while bordeaux caused foliage injury as well as a reduction in the size of the fruit. They also found that copper dusts caused only slight reduction in the size of the cherries and no foliage injury. Brooks and Fisher (1) observed that sweet cherries showed serious dwarfing of the fruit if sprayed with bordeaux or self-boiled lime-sulfur.

Lime-sulfur.—Lime-sulfur 1–40 has been the standard spray in this State for English Morello. When applied late in the season it may cause a stunting and turning inward of the edges of the leaves as well as a dwarfing of the fruit. It is possible that the fungicide either combines with the bloom of the fruit so as to permit greater evaporation, or accentuates injuries made by previous applications of sprays containing lead arsenate, causing desiccation of the fruit. Dutton and Wells (3) obtained better leaf-spot control with this fungicide than with bordeaux and observed very little foliage injury and only slight dwarfing of the fruit.

Wettable sulfur.—The Station orchard was given the first application of lime-sulfur solution, but the later applications were those of wettable sulfur with 3 pounds of lead arsenate. The leaves were of a dark green color without any rolling of the edges. At harvest time there was found a trace of a bright discoloration at the distal end of the pedicels, apparently due to the excess of the insecticide that was used. Altho its efficiency against the shot-hole fungus was not severely tested in 1926, this spray appears to be a promising substitute for lime-sulfur solution as a late summer spray.

Sulfur dust.—Dutton and Wells (3) found that the dusts were not as efficient as the liquid sprays for the control of the leaf-spot. They also noted that neither the sulfur nor the copper dusts caused foliage injury and but slight reduction in the size of the fruit. However, Dutton (2) stated that the sulfur dust did not control the "small cherry" which he believed due to *Coniothyrium fuckelii*, but which the writer believes to be lead arsenate injury. Examination of the local orchards revealed that some were free, while others showed from 3 to 5 per cent of the pedicels injured but with little or no dwarfing of the fruit. It appeared that the seasonal conditions did not bring out the full effect of the injury observed on the pedicels. It was apparent, however, that the accumulation of sulfur-lead-arsenate dust at the junction of the fruit and the pedicels caused injury, and hence too heavy applications should be avoided.

Lead arsenate.—In the past, it has been assumed by some writers that since acid lead arsenate was a comparatively stable compound and but slightly soluble in water, little injury was to be expected from its use. When tried on stone fruits, however, serious injury resulted. Cherries and plums are not as susceptible to injury as peaches, but investigations on the latter fruit throw light on the possible solution of the injury to the English Morello cherry. Haenseler and Martin (7) described a lead arsenate injury to twigs and foliage of the peach which is often mistaken for the shot-hole produced by *Bacterium pruni*. They found that the addition of 4 pounds of hydrated lime to 1½ pounds of lead arsenate in 50 gallons still produced injury. Mogendorff (8) suggests that more lime should be used than is employed in the dry-mix formula of 8–4–50. Fernald and Bourne (4) found that injury to cherry foliage is likely to occur at any time when the temperature and relative humidity are higher than that found between the range of 67° and 90 per cent and 92° and 47 per cent, respectively. It is to be expected that the addition of a fungicide

high in lime content would permit the safe use of lead arsenate at a higher range than that given. Just where that limit is to be found is unknown at present, but orchardists should avoid spraying on hot, sultry days so as to reduce injury to a minimum.

SPRAY SCHEDULE

From the foregoing it is evident that there is no absolutely safe fungicide, for each has its limits and dangers. With greater efficiency in combating fungi and insects there is usually associated a greater tendency toward injury. Since the English Morello is not subject to San Jose scale or the brown-rot fungus, application of a spray usually is not necessary before petals fall. Since this variety is subject to the shot-hole fungus, it is necessary to apply at least three to four sprays for its control. Such sprays could be made at petal fall and at intervals of two weeks were it not for the presence of insect pests, such as curculio and the cherry fruit fly. The investigations of Glasgow and Gambrell (6) with the latter insect would indicate that the injury from that pest was commercially more serious than defoliation due to leaf-spot. They have found that the third and fourth applications were necessary for the control of the fruit fly. Unfortunately, the pedicels at that time are susceptible to lead arsenate injury, such susceptibility increasing as the season advances. It appears necessary to effect a compromise on these two sprays. If heavy applications of a dust were used, pedicel injury resulted, and if the applications were light the cherry fruit fly was not properly controlled. If lime-sulfur was used in combination with lead arsenate, pedicel injury occurred, especially in hot sultry weather, altho the fruit fly was properly controlled. If wettable sulfur was used with the lead arsenate, the fruit was almost free from pedicel injury and from the cherry fruit fly; but its efficiency toward the shot-hole fungus was not demonstrated. In a season when the rains are not well distributed the fruit may show discoloration from lime-sulfur solutions, and, to a lesser degree, from applications of wettable sulfur. Considering the discoloration of the fruit at harvest time and the highest efficiency with the least injury, it appears that the most satisfactory procedure is to use lime-sulfur solution for the first three applications. For the fourth application a light dose of 90–10 sulfur-lead-arsenate could be substituted, and if leaf-spot is abundant another light application of plain sulfur dust ought to be made before harvesting. Where a duster is not available, or in hot sultry weather, wettable

sulfur could be substituted in the third and fourth applications.

With the cooperation of P. J. Parrott of the Department of Entomology of this Station, the spray schedule best suited for the English Morello cherry is outlined below.

English Morello Cherry Spray Schedule

Time of application	Spray mixture	Enemy	Dust mixtures†
1. When petals fall	Lime-sulfur 2½ gallons Arsenate of lead 2½ pounds* Water to make 100 gallons	Leaf-spot Curculio	90-10 sulfur-lead-arsenate dust
2. Three to four days after shucks fall	Lime-sulfur 2½ gallons Arsenate of lead 2½ pounds* Water to make 100 gallons	Leaf-spot Curculio	90–10 sulfur-lead-arsenate dust
3. As Montmorency cherries show red on one side	Lime-sulfur 2½ gallons Arsenate of lead 2½ pounds* Water to make 100 gallons	Maggot Leaf-spot	90–10 sulfur-lead-arsenate dust
4. Two weeks later	Lime-sulfur 2½ gallons Arsenate of lead 2½ pounds* Water to make 100 gallons	Maggot Leaf-spot	90–10 sulfur-lead-arsenate dust
5. After picking	Lime-sulfur 2½ gallons Arsenate of lead 1 to 2 pounds‡ Water to make 100 gallons	Leaf-spot Slug	90–10 sulfur-lead-arsenate dust

*The amount of arsenate of lead is given for powder form; if paste form is used, twice as much is required.

†If heavy rains are of frequent occurrence, apply dust mixtures about one week after the first treatment and make a third application one week after the second treatment.

‡If slugs or other insects are not present lead arsenate may be omitted.

If apprehensive of spray injury to pedicels in hot, humid weather, the most satisfactory alternative for lime-sulfur solution is wettable sulfur. The formula to which the usual amount of lead arsenate may be added is as follows:

Superfine sulfur	16 pounds
Hydrated lime	8 pounds
Calcium caseinate (Kayso)	1 pound
Water	100 gallons

SHRIVELING OF PRUNES

The results obtained with the English Morello cherry led the writer to investigate the effect of similar applications of lead arsenate on prunes. Orchardists have long observed that some varieties of prunes

have a tendency to shrivel prematurely at the stem end of the fruit. It was difficult to distinguish the premature shriveling due to insect, mechanical, or lead arsenate injury from that normally produced later in the season. The injuries tend to hasten or accentuate dropping and shriveling so that the fruit is not cured properly. Prunes that have hung to the trees in the process of curing appear the most desirable for they are of the richest flavor and the sweetest. In 1926, with the late sugar production, the normal shriveling was almost lacking at harvesting. All varieties do not produce the shriveled fruit, for, generally speaking, the meaty fruit high in sugar production shows this characteristic to the highest degree. According to Richard Wellington, Associate Horticulturist at this Station, the following varieties of plums and prunes showed this characteristic in the Station orchard: Agen, Althann, Englebert, Golden Drop, Hungarian, Imperial Epineuse, Italian Prune, Madame Nicolle, McLaughlin, Pearl, Purple Gage, Late Muscatelle, Red Date, Reine Claude, and Sannois.

The premature shriveling, which was readily distinguished from the normal curing of the fruit, was more common when bordeaux was in vogue than is now found with lime-sulfur or wettable sulfur.

Sometimes there was found a red brown discoloration of the pedicels similar to that observed on the cherry. Examination showed no fungus, but still the sap flow had been interrupted so as to permit desiccation of the fruit. A grower at Northeast, Pa., reported that, in 1925, Italian and German prune showed 50 and 75 per cent of shriveled fruit, respectively. As he had a mixed orchard it was impossible to apply lime-sulfur 1–40, for fear of injuring the tender varieties. Hence, a dilution of 1–70 or even 1–100 lime-sulfur was applied to which 3 pounds of lead arsenate had been added. It is possible that at that dilution there is not sufficient free lime to counteract the toxic properties of free arsenic that might be liberated.

In order to test the injurious effect of lead arsenate, one tree each of Agen and Italian prune in the Station orchard was sprayed, on August 9, with a mixture of 2½ pounds of powdered acid lead arsenate to 100 gallons of water. Double this dosage was applied to one tree each of Agen, Italian, and German prune. Before the end of the month much defoliation and spray injury was apparent and resembled that produced by the shot-hole fungus. The pedicels showed the same type of injury as observed on the cherry. The fruit was ready to drop as the season advanced, being dwarfed and shriveled as shown in

Plates III and IV. The fruits of Agen and German prune, which were not severely injured, hung to the tree and showed shriveling at the stem end, while those more severely injured showed a desiccation thruout. In the case of the Italian prune, the fruit dropped prematurely without showing excessive desiccation. However, the fruit was much undersized when compared to a check. On August 31, the checks were given an application of wettable sulfur containing 2½ pounds of lead arsenate to 100 gallons. No injury was observed from this spray until September 29 when traces of the red-brown discolorations were found on the pedicels on some trees. This injury was reflected in the number of prunes that dropped between September 22 and 29. As the lead arsenate had been applied by means of a bucket pump on August 9, the spray failed to reach the top of the high trees. On September 29, when the final observations were made, the tops of the trees were loaded with fruit and there was no defoliation, while the branches covered with lead arsenate were severely defoliated with only an occasional fruit present. There was greater defoliation when the double dosage was administered than when normal dosage was used. The Agen and German prune showed more injury than did the Italian prune. The drops were picked up at weekly intervals and these data are given in Table 1. Only a few of the many trees of the Italian prune served as checks and there was no more dropping on other trees than on the checks counted.

TABLE 1.—NUMBER OF DROPS FROM PRUNE TREES SPRAYED ON AUGUST 9 WITH VARIOUS AMOUNTS OF LEAD ARSENATE IN WATER.

Row No.	Tree No.	Variety	Pounds of lead arsenate per 100 gallons	Number of drops			
				Sept. 15	Sept. 22	Sept. 29	Total
36	12	Agen	2.5	929	348	677	1,954
36	13	Agen	5.0	1,127	152	218	1,497
36	36	Italian prune	2.5	652	335	270	1,257
36	37	Italian prune	5.0	745	309	404	1,458
32	48	German prune	5.0	1,523	362	588	2,473
32*	1	Agen	0	41	64	372	477
36*	23	Italian prune	0	36	53	245	334
37*	55	Italian prune	0	35	65	picked	100
37*	56	Italian prune	0	52	111	picked	163

*Unsprayed checks.

As the brown-rot was not the causal agent of the dropping of the fruit, it was evident that lead arsenate when applied alone caused a shriveling, dwarfing, and dropping of prunes. The slight injury to the pedicels brought about by the use of dry mix, plus lead arsenate,

hastened the shriveling of the fruit at the stem end. Hence, it is apparent that the pedicels of some prunes are subject to injury similar to that found on the English Morello cherry.

CONCLUSIONS

Investigators have found acid lead arsenate more efficient in the killing of most insects than the less active basic lead arsenate, so that now the former is considered the standard insecticide for fruit trees. In attaining this efficiency, safety from injury was sacrificed, so that at present it is difficult to state just how maximum efficiency may be attained with minimum injury. A spray practise that has proved satisfactory for the control of the shot-hole fungus may not be sufficient to combat successfully an insect pest, such as the cherry fruit fly. The control of that insect is still under investigation by the entomologist of this Station.

When lead arsenate is combined with a fungicide, the former may exert an injurious effect, depending somewhat upon the amount of free lime present. Pedicel injury to Morello cherry was found where the lead arsenate was combined with bordeaux, lime-sulfur solution, wettable sulfur, and copper and sulfur dusts. The least injury was observed with wettable sulfur and where *light* applications of sulfur-lead-arsenate dust had been made. The bordeaux and copper dusts have been shown by others to cause foliage injury, while the lime-sulfur solution may cause a stunting and turning up of the edges of the leaves. The sulfur-lead-arsenate dust and wettable sulfur showed the most perfect foliage and fruit in 1926, but the absence of leaf-spot infection did not test its efficiency in the control of the fungus. In general, the degree of injury was dependent upon the vigor of the tree, the amount of spray or dust applied, the coarseness of the spray, and especially upon seasonal conditions, such as rainfall, humidity, and temperature.

Investigation of the effect of lead arsenate on some varieties of prunes shows that they also are susceptible to pedicel injury and that the effect is similar to that produced on the English Morello cherry. It was found that the foliage of some prunes is very susceptible to burning, which causes lesions resembling those made by the shot-hole fungus *Coccomyces prunophorae* on this host.

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